Modular Walker Handles for a Motorized Posterior Walker

Disparities in Cerebral Palsy Treatment: A Comparative Analysis of Pakistan and the United States

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction:

Cerebral Palsy is a debilitating congenital condition that affects approximately one in 345 children in the United States (Centers for Disease Control and Prevention). CP results from abnormal brain development or damage to the developing brain, leading to difficulties in controlling muscles, which therefore affect movement and posture. To combat this issue, the gait lab at UVA is working to create a motorized posterior walker to optimize energy consumption during walking. The walker requires handles attached with force transducers, which are being developed as part of my senior capstone project. In Pakistan CP affects 1.22 in 1000 children. However, that number might alter due to lack of technology in the third world country. Knowing that CP requires an attentive treatment plan and that Pakistan does not have updated research on CP, especially when compared with the states, the STS portion of this paper aims to focus on the variation amongst treatments in Pakistan and the States.

Technical Section:

Cerebral palsy (CP) is a congenital disease that affects the development of motor and balance skills, affecting one in 345 children in the United States (Centers for Disease Control and Prevention). It is caused by abnormal brain development or damage to the developing brain which ends up affecting the child's ability to control his or her muscles. The symptoms of CP range from patient to patient, however, they commonly include difficulty with movement and maintaining posture (National Library of Medicine). The Gait Lab is in phase two testing of a clinical trial to create a motorized posterior walker to be used by children affected with CP to optimize energy consumption while walking. Motorized means that the walker is powered so that the children do not have to consume energy to push the walker (Physiopedia). Additionally, the walker is posterior to help correct posture while walking, as suggested by previous research

(Peters). Figure one below shows the current model of the walker in the lab. To measure effectiveness of the design of the walker, healthy children and those affected with CP are invited to the lab to participate in a clinical trial. Various instruments are placed on the patient during the clinical trial to measure energy consumption and gait cycle. These include electromyography (EMG) machines (measuring electrical response in response to nerve stimulation of the muscle in the leg), a VO_2 mask and monitor (measuring maximum oxygen consumption during the various walking trials to show aerobic endurance), and reflective markers (placed over various bones of the patient and can be transferred to the software used to be analyzed to track motion and deviation with respect from one another). The patient is required to walk under three different circumstances- one without any external assistance, one using a standard posterior walker, and one using the motorized posterior walker- during data collection. The two walkers contain handles, which come attached with force sensors to measure force grasped with the hands while in use, which must be interchanged between the two walkers during the trials. However, transferring between the two walkers takes a team of people and several minutes. When working with children this becomes quite difficult as they are often reluctant to sit for long periods of time while wearing equipment. This can lead to a calibration error of the other equipment being worn by the patient and thus a skewing of the data from the unaccounted variations in motion. Each force transducer starts out at almost $6,700 (ATI), meaning an additional set of handles is unattainable. Therefore, the capstone is focused to redesign efficient, modular handles with embedded force transducers which can easily be transferred between the two tested walkers in hopes to simplify and improve the accuracy of the data collection (Russell et al., 2011).

Sociotechnical Synthesis:

The last section explained in detail the technology being created at one specific laboratory in the United States. Unfortunately, such does not exist in Pakistan, a third world country located in southern Asia. According to a study conducted in the Khyber Pakhtun region of Pakistan in 2017, the prevalence of CP in Pakistan is 1.22/1000 live births. This number is much lower than that stated for the US however can be explained for a couple of reasons. The first being that the number previously stated is for live births. Meaning that is the number for children diagnosed with CP as soon as they are born. CP, however, can be diagnosed anytime between the ages of 0-8, especially as a result of diseases that cause damage to the brain such as meningitis or typhoid (Tharwani). These diseases are typically extremely rare in the United States as there is a high availability of vaccinations to prevent them. In a third world country, such as Pakistan, there is a higher prevalence of such diseases as there are fewer vaccines available and less hygienic environments- i.e. access to clean water (Tharwani). The reason neurological disorders can often lead to CP being developed despite being born healthy is since there is a risk of damage occurring in the spinal cord, such as an infection or damaging of nerves in the brain stem, connected to the spinal cord (Globalwaters). Despite the cause of CP being diagnosed after birth, most of these cases are likely not reported in the earlier statistic.

Another reason for the statistic appearing lower is that it represents reported cases of CP. While some of the more modern cities in Pakistan (including Lahore, Islamabad, and Karachi) may mirror technologies relatively similar to those in the states, some of the rural areas (such as Hunza valley, Gujranwala, and many other smaller villages) do not have an updated system yet. Due to this, most of their records are not updated digitally, rather kept as paper forms (Refworld). Since they are not available digitally, they likely were not accounted for when the survey for the study was sent out. Limited awareness on diagnosis of CP has a direct correlation

with lack of treatment, or less available therapies for the children. CP as a whole represents an under represented and under researched community in Pakistan. With there being limited knowledge on the prevalence of CP, the therapies available also become a question of focus. For the sociotechnical focus of this STS paper, I plan on conducting a study to compare the therapies available for CP in the United States and in Pakistan from the perspective of both the doctors and patients. This will be done through a qualitative study analysis where I will conduct interviews on doctors and their patients with CP in both Pakistan and the states. Furthermore, I plan on sending out a followup survey for patients where they can express their satisfaction with the treatment they are receiving. The questions will all be answered on a scale of 1-5 (most satisfied to least satisfied) so that the analysis of it can be easily quantified and measured. Doing so will hopefully raise awareness on the privilege, and lack thereof, of availability of treatments and therapies for individuals with cerebral palsy.

Conclusion:

Through the improved design of the modular handles, the data collection for this study will be completed in a shorter span of time and with reduced errors. When working with children, it is crucial that data collection be performed with minimum wait times in between trials as there is a high risk of them maneuvering with other equipment attached to them, such as the vO_2 monitor, placement markers, and EMGs. This improvement will eventually allow for the creation of a motorized posterior walker for children affected with cerebral palsy. This serves as one of the many treatments available for children in the United States. Unfortunately such does not seem the case for Pakistan, which fails to account for an accurate number of diagnosed individuals. The proposed socio-technical study aims to compare the CP therapies in the United

States versus those available in Pakistan. By recognizing the challenges faced in diverse settings, this research hopes to acknowledge the gaps in healthcare in underrepresented populations.

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